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NATIONAL DAM SAFETY PROGRAM. SOUTH RIVANNA DAM (VA 00302), JAME--ETC(U)
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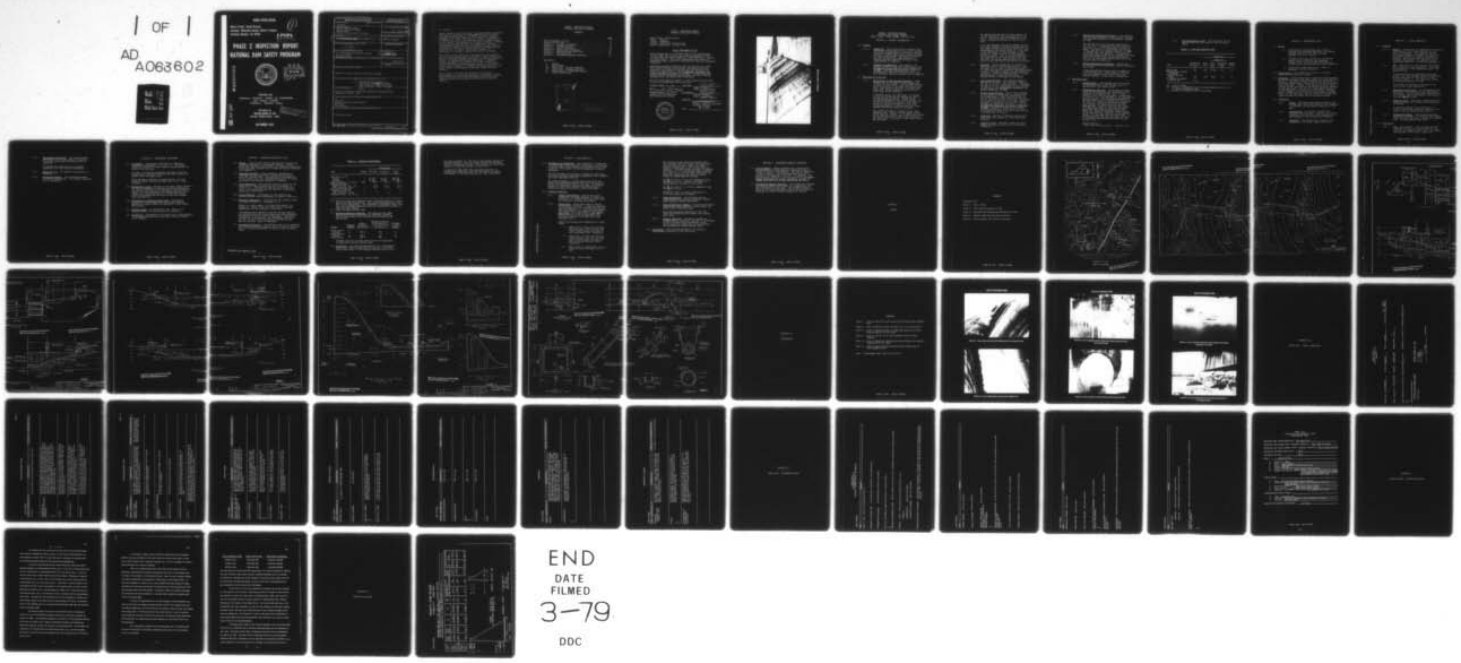

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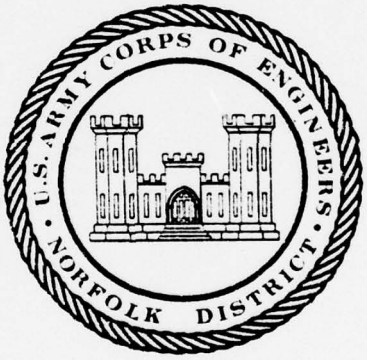
JAMES RIVER BASIN

Name of Dam: South Rivanna
Location: Albemarle County, State of Virginia
Inventory Number: VA 00302

LEVEL II

# PHASE I INSPECTION REPORT
# NATIONAL DAM SAFETY PROGRAM








PREPARED FOR
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510



PREPARED BY
MICHAEL BAKER, JR., INC.
BEAVER, PENNSYLVANIA 15009

SEPTEMBER 1978

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## REPORT DOCUMENTATION PAGE

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South Rivanna Dam Number (VA ØØ3Ø2),
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Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service,
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Dams - VA
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Dam Safety
Dam Inspection

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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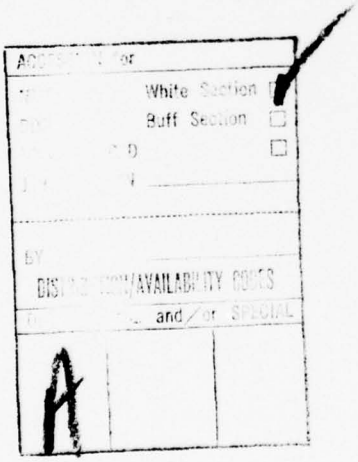


PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: South Rivanna
State: Virginia
County: Albemarle
Stream: South Fork Rivanna River
Date of Inspection: 26 July 1978

## BRIEF ASSESSMENT OF DAM

South Rivanna Dam is a concrete gravity dam approximately 70 feet high and 700 feet long owned and operated by the Rivanna Water and Sewer Authority, Charlottesville, Virginia, for water supply. The visual inspections and review of engineering data indicate no deficiencies requiring emergency attention.

Hydrologic analysis indicates that the spillway will pass the Probable Maximum Flood without overtopping the dam. Structural calculations indicate that the dam meets the stability requirements of the Recommended Guidelines for Safety Inspection of Dams with respect to overturning and sliding for the Probable Maximum Flood, one-half Probable Maximum Flood, and normal pool conditions.

The only item requiring repair is the eroded concrete apron on the left downstream side of the dam.

MICHAEL BAKER, JR., INC.

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer

SUBMITTED: Original signed by JAMES A. WALSH
James A. Walsh
Chief, Design Branch

RECOMMENDED: Original signed by ZANE M. GOODWIN
Zane M. Goodwin
Chief, Engineering

APPROVED: Original signed by: Douglas L. Haller
Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: SEP 27 1978

COMMONWEALTH OF VIRGINIA
MICHAEL BAKER III
NO. 3176
CERTIFIED PROFESSIONAL ENGINEER

**OVERALL VIEW OF DAM**

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: SOUTH RIVANNA ID# VA 00302

SECTION 1 - PROJECT INFORMATION

## 1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972 authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

## 1.2 Description of Project

1.2.1 Description of Dam and Appurtenances: South Rivanna Dam is 700 feet in total length and 70 feet in total height. The concrete gravity spillway section is 525 feet long and 54 feet high. The overflow spillway is an ogee type with small chutes located at the left and right ends of the spillway.

A concrete apron, 320 feet wide, is located at the toe of the dam and extends 40 feet in the downstream direction. Eighty chute blocks are present at the toe of the dam, and 53 baffle blocks are located 15 feet downstream of the chute blocks in a stilling basin impounded by a concrete end sill which extends the entire width of the apron.

The intake building is located in the right abutment area. Three 2.5 feet square sluice gates serve as intakes, two of which are located in the upstream face of the intake structure. The third gate is adjacent to the right end of the spillway.

The design drawings show 32 apron drains on 10 feet centers at the downstream end of the apron. The drains were not observed at the time of inspection because of flow in this area.

A six feet diameter drainpipe extends through the right abutment from the upstream face of the intake structure and exits about 100 feet downstream of the apron (Plate 1). This pipe is for emergency or rapid drawdown of the reservoir. There are two 36 inch diameter control conduits. One is located adjacent to the right end of the overflow spillway, and the other is located approximately 115 feet south of the left end of the overflow spillway.

1.2.2 Location: South Rivanna Dam is located on the South Fork of the Rivanna River 0.5 mile upstream of U.S. Route 29 and approximately 0.7 mile upstream of Carrsbrook and Westmoreland, Virginia (two small suburbs of Charlottesville, Virginia). There are approximately 200 homes and businesses located in both towns. A Location Plan is included in this report.

1.2.3 Size Classification: The maximum height of the dam is 70 feet. The reservoir volume to the top of dam is 17,800 acre-feet. Therefore, the dam is in the "intermediate" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

1.2.4 Hazard Classification: Due to the proximity of the Towns of Carrsbrook and Westmoreland with approximate collective populations of 800 to 900 people, many lives could be lost in the event of failure of the dam. Therefore, this dam is clasified in the "high" hazard category as defined by Section 2.1.2 of the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned by the Rivanna Water and Sewer Authority, Charlottesville, Virginia.

1.2.6 Purpose of Dam: The dam is used for water supply for Charlottesville and surrounding communities.

1.2.7 Design and Construction History: The existing facility was designed for the owner by Polglaze and Basenberg Engineers of Birmingham, Alabama in 1964.

The dam was built by Faulconer Construction Co. in 1966. A reinforced concrete apron was replaced, and it has subsequently washed out again. The apron is being washed out because it extends past the overflow spillway in order to protect the left abutment. This problem could have been avoided if the abutment had been excavated further back during construction. This is the only known construction since the original dam construction.

1.2.8 Normal Operational Procedures: Normal pool is controlled by the spillway crest at elevation 382.0 feet.

Intake through the sluice gates is pumped to a filtration plant located south of the dam. Flow was present in both north and south control conduits at the time of inspection.

1.3 Pertinent Data

1.3.1 Drainage Area: The drainage area of the dam on the South Fork of the Rivanna River is approximately 259 square miles.

1.3.2 Discharge at Dam Site: The maximum recorded flood on the South Fork of the Rivanna River occurred on 18 August 1955, prior to the design of the South Rivanna Dam. A discharge of 30,200 c.f.s. was recorded at the Earlysville gauging station. The estimated discharge at the "proposed" dam site during this flood was 36,190 c.f.s. based on additional drainage area between the gauging station and the proposed dam. Based on the spillway length, the resulting height or flow over the weir would have been approximately seven feet. There are, however, high water marks present at the dam site that indicate a flow approximately 7.8 feet deep over the ogee crest. It is believed that the flood occurred in 1969. The discharge associated with this flood is 76,000 c.f.s.

Ungated Spillway
Pool level at top of dam . . 158,400 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown on the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

| Item | Elevation feet M.S.L. (a) | Reservoir Area acres | Reservoir Capacity Acre-feet (b) | Reservoir Capacity Watershed inches (c) | Reservoir Length miles |
|---|---|---|---|---|---|
| Top of dam | 400 | 895 | 17,800 | 1.3 | 9.7 |
| Maximum pool, design surcharge | - | - | - | - | - |
| Ungated spillway crest | 382 | 410 | 6400 | 0.5 | 7.0 |
| Streambed at centerline of dam | 335± | - | - | - | - |

(a) U.S.G.S. datum.
(b) Storage is estimated from field measurements and U.S.G.S. 7.5 minute quadrangle maps.
(c) Based on 259 square miles of watershed.

## SECTION 2 - ENGINEERING DATA

2.1 Design:

1) Photocopies of the design plans done by Polglaze and Basenberg Engineers, Birmingham, Alabama dated May 1964 were reviewed (Plates 1, 2, 3, 4, and 5).

2) Storage curves and a portion of the design report done by Polglaze and Basenberg, January 1960, were also made available for review by the Rivanna Water and Sewer Authority.

3) Flood Plain Study done by U.S. Corps of Engineers, Norfolk District.

2.2 Construction: No construction history or as-built plans were available for review.

2.3 Operation: South Rivanna Dam is maintained and operated by the Rivanna Water and Sewer Authority, Charlottesville, Virginia. Records of water withdrawn are available at the chlorinating house. There are no records of spillway flows available. Intake is through three sluice gates located at the right end of the intake structure adjacent to the pump house. The water is then pumped through a 24 inch diameter cast-iron pipe to the water treatment plant. Normal pool elevation is maintained by constant flow over the ogee type spillway, and flow through both chutes located at either end of the ogee spillway.

2.4 Evaluation

2.4.1 Design: The design drawings provided by the Rivanna Water and Sewer Authority were adequate to determine the structural stability of the dam.

2.4.2 Construction: No as-built construction drawings were available. However, the visual inspection did not reveal any inadequacies in the concrete of the 12 year old structure.

2.4.3 Operation: The operational procedures are adequate for the water supply facilities.

## SECTION 3 - VISUAL INSPECTION

### 3.1 Findings

3.1.1 General: The dam and its appurtenant structures were found to be in good condition at the time of inspection. The problems noted do not require remedial treatment but should be corrected as part of a regular maintenance program. The deficiencies are noted in the following paragraphs. The complete visual inspection check list is given in Appendix III.

3.1.2 Dam: Generally, all the concrete structures of the dam are in good condition. Only very minor spalling of the downstream face of the dam was noted.

A concrete apron just downstream from the chute in the left abutment area was undermined by the high flows of 1969 and is in poor condition (Photo 6). This apron was eroded and repaired previous to 1969.

No evidence of seepage was present at the time of the visual inspection.

3.1.3 Appurtenant Structures: No inadequacies were observed in the concrete of any appurtenant structures. The only deficiency observed was the concrete apron downstream of the chute in the left abutment area.

3.1.4 Reservoir Area: Some minor sedimentation was observed in the left abutment just upstream of the dam.

An aeration process in the reservoir is used to oxydize the chemicals present in the runoff from surrounding farms (Photo 5).

3.1.5 Downstream Channel: Some cobbles and small boulders are present in the downstream channel. There are also some small islands with vegetation. No deficiencies were noted.

### 3.2 Evaluation

3.2.1 Dam: The concrete in the spillway and non-overflow sections is in good condition and requires no remedial repair work. No seepage was noticed at the time of inspection.

3.2.2 Appurtenant Structures: The concrete apron downstream of the chute should be repaired to prevent bank erosion during periods of high flow.

No seepage was observed at the abutment junctions or at any location downstream.

3.2.3 Reservoir Area: No further investigation is necessary.

3.2.4 Downstream Channel: The downstream channel is free of obstructions. No further investigation is necessary.

## SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Operational procedures are generally discussed in paragraphs 1.2.8 and 2.3. The normal reservoir elevation of 382.0 feet is controlled by the crest of the spillway.

The dam is visited by maintenance personnel from the Rivanna Water and Sewer Authority who also operate the nearby water treatment plant.

Rapid emergency drawdown is controlled by a 72 inch diameter tunnel from the upstream face of the intake structure.

4.2 Maintenance of Dam: Because of its water supply function, the dam is frequently visited by maintenance personnel. The concrete structures are generally in good condition except for minor spalling on the downstream face and a washout of a large portion of a concrete apron over riprap downstream from the chute in the left abutment area (see Photo 6).

4.3 Maintenance of Operating Facilities: Maintenance personnel of the Rivanna Water and Sewer Authority operate the control gates as required for water supply and overflow.

4.4 Warning System: At the present time, there is no warning system or evacuation plan in operation.

4.5 Evaluation: Maintenance of the dam by full time personnel of the nearby Rivanna Water and Sewer Authority appear to be adequate.

## SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 Design: South Rivanna Dam was designed by Polglaze and Basenberg Engineers of Birmingham, Alabama. Design plans were obtained from Rivanna Sewer and Water Authority along with some information on flood and design discharges (see Appendix V).

5.2 Hydrologic Records: Flood discharge information is available for the Earlysville stream gaging station from 1951 through 1966. The gage with a drainage area of 216 square miles was located approximately 5.6 miles upstream of the dam near Hydraulic, Virginia.

5.3 Flood Experience: The greatest flood of record on the South Fork of the Rivanna River had a discharge of 30,200 c.f.s. Although the dam was built after this event, this discharge would now result in a reservoir elevation of 388.5 feet.

5.4 Flood Potential: Performance of the reservoir by routing various flood hydrographs is shown in Table 5.1.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, paragraph 1.3.3.

Except for water supply, flow from the reservoir is automatic. Normal flows are controlled by the ogee shaped crest at an elevation of 382 feet.

Information about reservoir area and storage capacity was obtained from the Rivanna Water and Sewer Authority and Norfolk District, Corps of Engineers. Additional information on discharges, unit hydrograph ordinates, and the 100 year flood routing was provided by the Norfolk District, Corps of Engineers.

5.6 Overtopping Potential: The probable rise in the reservoir and other pertinent information on the reservoir performance in various hydrographs are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

| Item | Normal | Hydrograph 100 Year | 1/2 P.M.F. (a) | P.M.F. (a) |
|---|---|---|---|---|
| Peak flow, c.f.s. | | | | |
| Inflow | - | 51,600 | 82,700 | 165,400 |
| Outflow | - | 51,300 | 79,000 | 157,700 |
| Peak elevation, ft. M.S.L. | 382 | 390.8 | 393.7 | 399.9 |
| Ungated spillway | | | | |
| Depth of flow, ft. (b) | - | 8.8 | 11.7 | 17.9 |
| Avg. velocity, f.p.s. | - | 14.9 | 17.2 | 21.6 |
| Non-overflow section | | | | |
| Depth of flow, ft. | - | - | - | - |
| Avg. velocity, f.p.s. | - | - | - | - |
| Tailwater elev., ft. M.S.L. | - | - | - | - |

(a) These routings were computed using a unitgraph based on a drainage area of 268 square miles. The actual drainage area at the dam is 259 square miles. No adjustment for drainage area at the dam site was deemed necessary since the difference in areas is less than four percent.

(b) Depth includes velocity head.

5.7 Reservoir Emptying Potential: The reservoir has three drains that could be activated for emergency drawdown. The following table lists the pertinent information for each outlet:

| Outlet | Diameter (inches) | Invert Elevation (ft. M.S.L.) | Maximum Discharge With Reservoir at Spillway Crest (c.f.s.) | Drawdown to Invert (days) |
|---|---|---|---|---|
| North Control Conduit | 36 | 345.3 | 225 | 21 |
| South Control Conduit | 36 | 346.0 | 195 | 25 |
| Drain Tunnel | 72 | 340.0 | 860 | 5 |

Drawdown from the spillway crest could be accomplished in three days with all outlets open.

5.8 Evaluation: The South Rivanna Dam with an "intermediate" size-"high" hazard classification must pass a spillway design flood equal to the Probable Maximum Flood (P.M.F.).

As shown in Table 5.1, the P.M.F. was routed through the dam and reservoir, and was passed through the spillway without overtopping the dam. The spillway has sufficient capacity to pass 100 percent of the P.M.F.

It should be indicated that conclusions pertain to present day conditions, and that the effect of future development on the hydrology has not been considered.

## SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The foundation is comprised of light gray quartz monzonite according to the geologic cross-sections. Rock formations are massive with some jointing. The bedrock is the Pre-Cambrian Lovinston Formation.

The left abutment of the dam is founded on light gray and brown coarse-grained quartz monzonite with a massive structure and some jointing.

The right abutment is on hard quartz monzonite and green seamy hornblend gabbro with traces of chlorite schist as indicated on the boring logs. The bedrock exposure in the right abutment area downstream is blocky and highly vertically jointed with seams.

6.2 Stability Analysis

6.2.1 Visual Observations: During the visual inspection, no misalignments in either the horizontal or vertical direction were noted. No structural cracking was present.

6.2.2 Design Data: Since there were no design calculations available, a stability analysis was performed on a full section through the dam (see Appendix V). The stability computations were made in accordance with Gravity Dam Design, U.S. Army Corps of Engineers, Manual EM 1110-2-2200 25 September 1958 (including Change 2) and ETL 1110-2-184 February 1974.

Stability analyses were completed for three cases:

I. Water level 18 feet over spillway elevation 382.0 with no ice load (the 18 feet height was based on the calculated P.M.F. elevation).

II. Water level 12 feet over spillway elevation 382.0 with no ice load (the 12 feet height was based on the calculated one-half P.M.F. elevation).

III. Water level at normal pool with ice load and normal tailwater of six feet.

The results of the stability analyses show the resultant force is within the middle one-third of the base and a factor of safety against sliding that is well above that the required. The high values of angle of internal friction ($\phi$ = 31°) and average shear strength ($S_o$ = 1825 p.s.i.) of the quartz monzonite are primarily responsible for the very large factor of safety against sliding.

The $\frac{\Sigma H}{\Sigma V}$ for Case I is 0.81 as compared to the allowable of 0.65. However the factor of safety against sliding is very large.

The $\frac{\Sigma H}{\Sigma V}$ for Case II is 0.65 as compared to the allowable of 0.65.

The $\frac{\Sigma H}{\Sigma V}$ for Case III normal conditions is 0.45, well below the allowable.

6.2.3 Operating Records: The structure has no instrumentation to measure movements induced under maximum loading conditions.

6.2.4 Post-Construction Changes: No post-construction changes have been made which would affect the water level or dam stability.

The concrete apron downstream of the left chute was undermined and eroded twice during high flows.

6.2.5 Seismic Stability: The dam is located in Seismic Zone 2; therefore, the dam is considered to have no hazard from earthquake, since static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: South Rivanna Dam meets all stability requirements according to EM 1110-2-2200.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

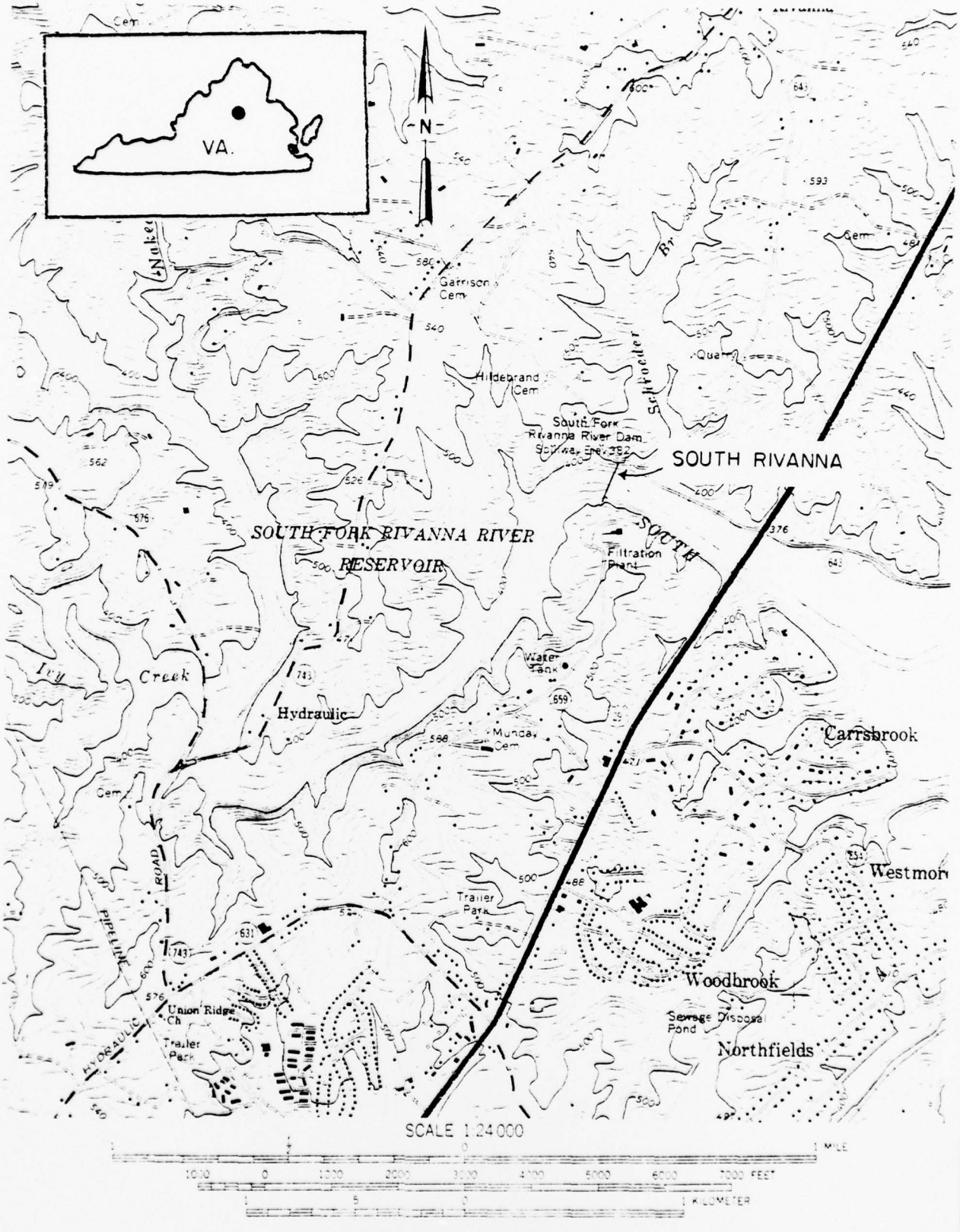
7.1 Dam Assessment: Design drawings and a flood plain investigation provided adequate engineering data to conduct a Phase I investigation. The dam is generally in good condition. The spillway passes the P.M.F. without an overtopping of the dam. In addition, the dam meets the stability criteria required by the Recommended Guidelines for Safety Inspection of Dams for normal pool with an ice load and during the P.M.F.

7.2 Recommended Remedial Measures: The inspection revealed one item of repair which should be incorporated with dam maintenance by the owner. The eroded concrete apron on the left downstream side of the dam should be repaired to prevent further progressive erosion.

# APPENDIX I

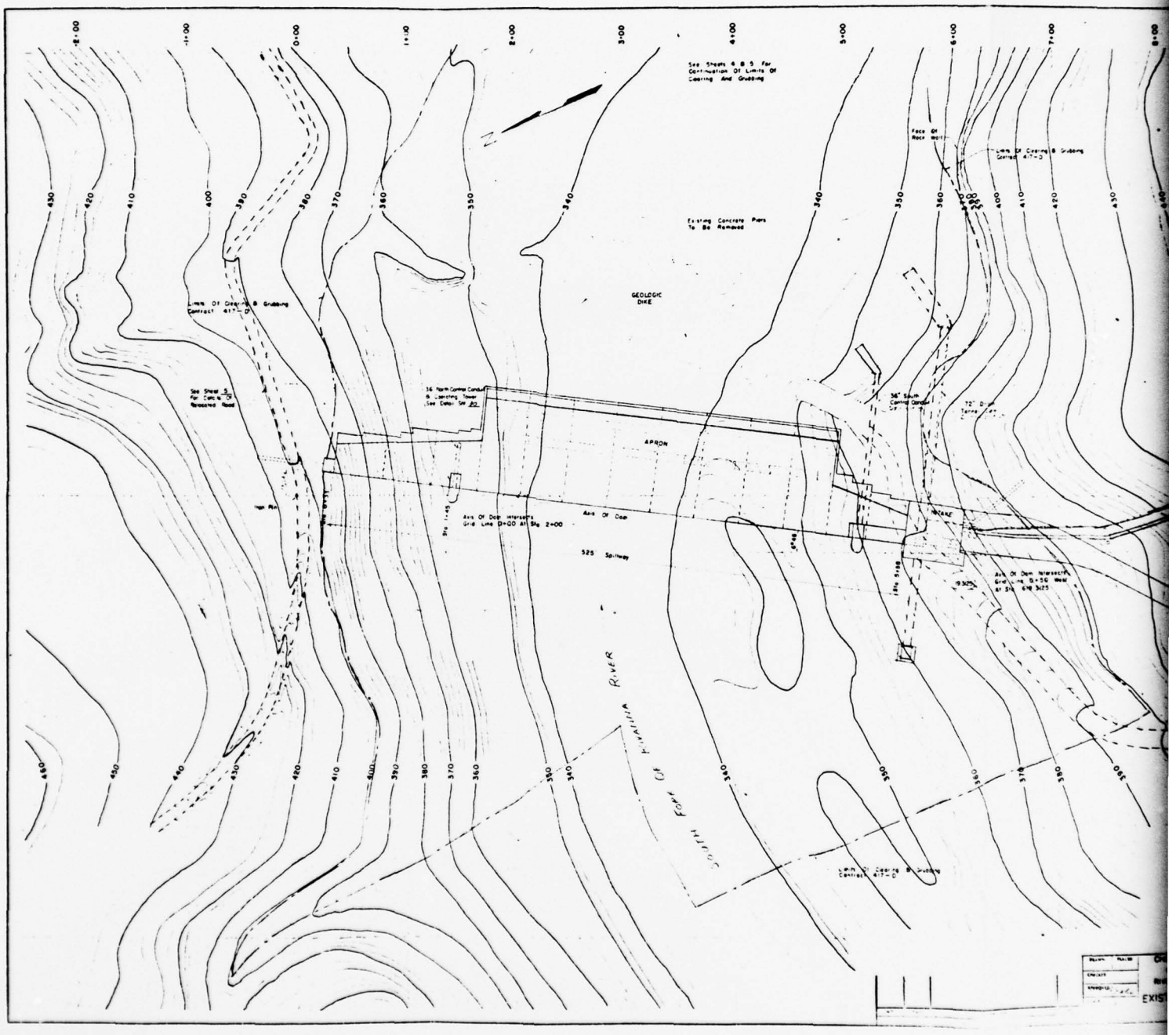
# PLATES

CONTENTS




LOCATION PLAN

SOUTH RIVANNA

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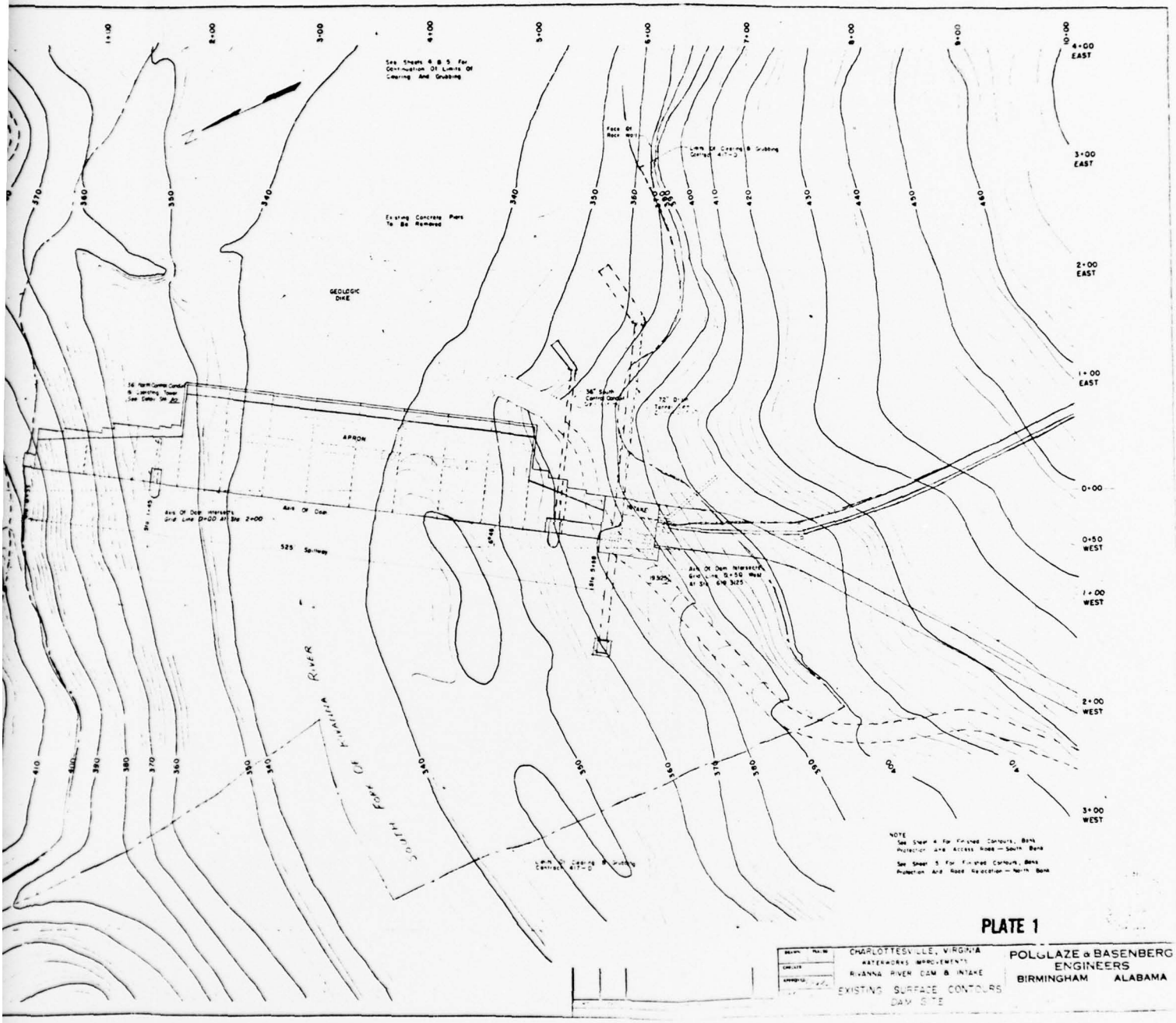
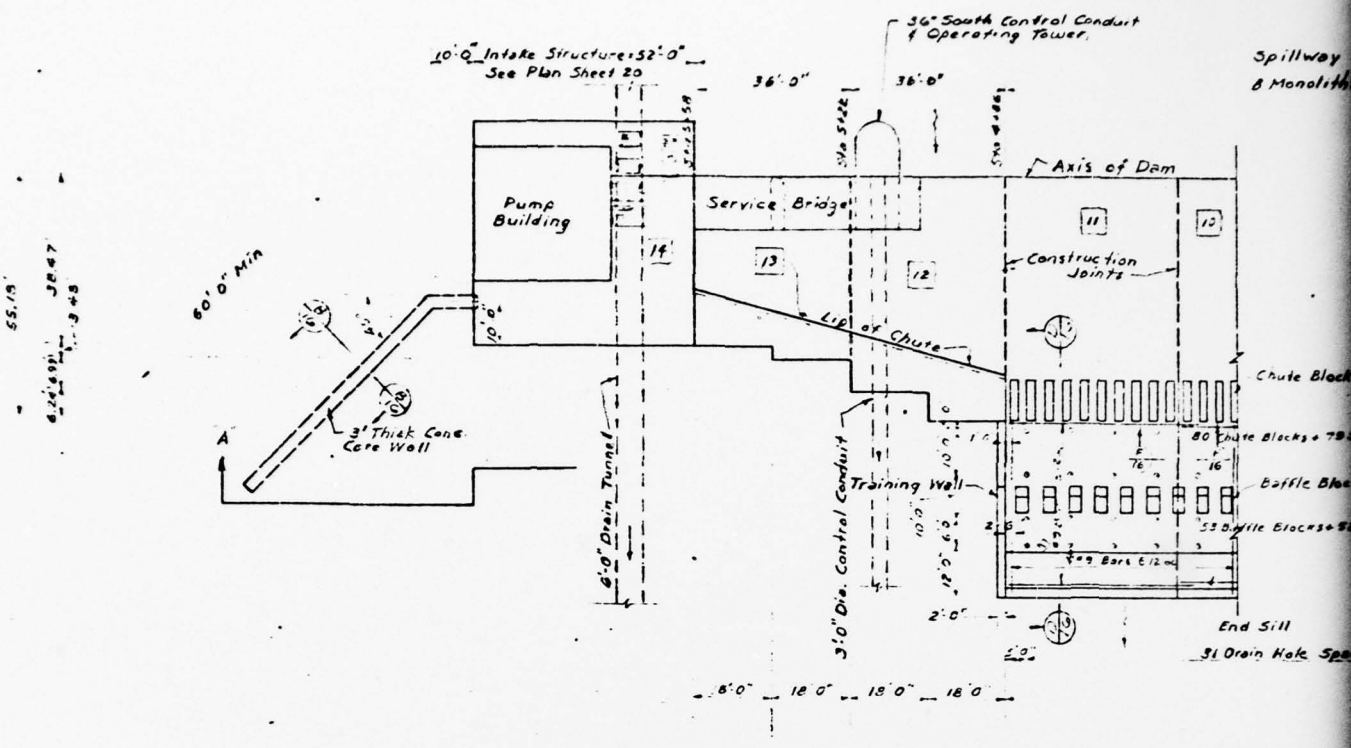



PLATE 1

CHARLOTTESVILLE, VIRGINIA
WATERWORKS IMPROVEMENTS
RIVANNA RIVER DAM & INTAKE
EXISTING SURFACE CONTOURS
DAM SITE

POLOLAZE & BASENBERG
ENGINEERS
BIRMINGHAM ALABAMA

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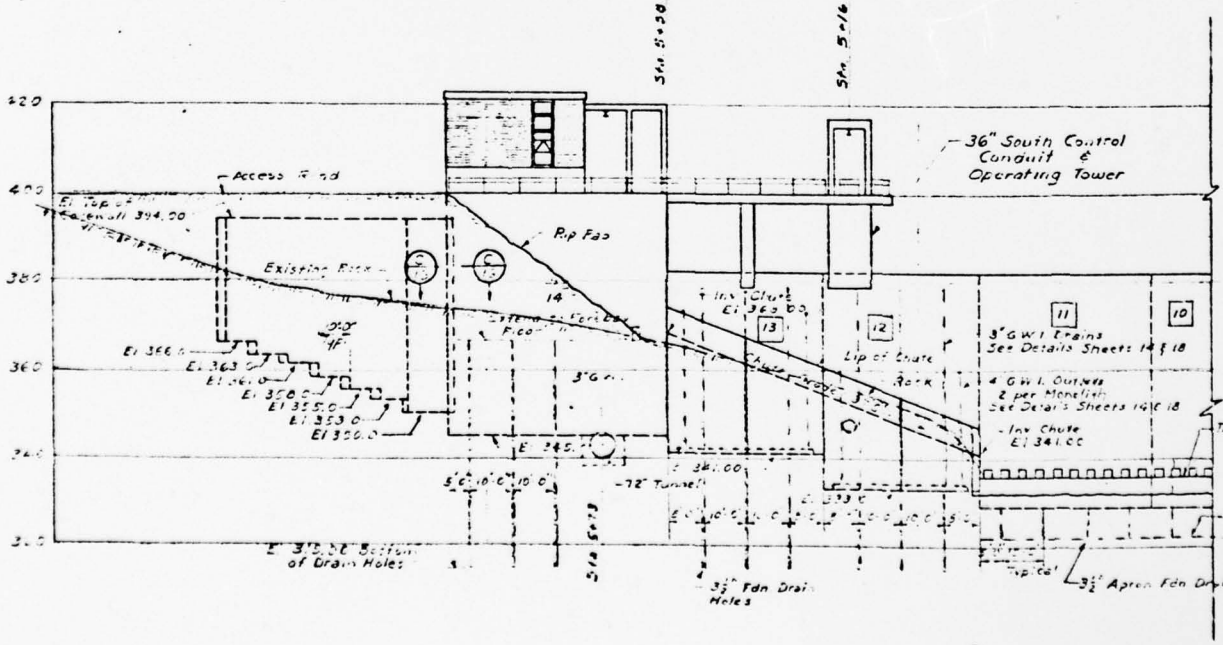




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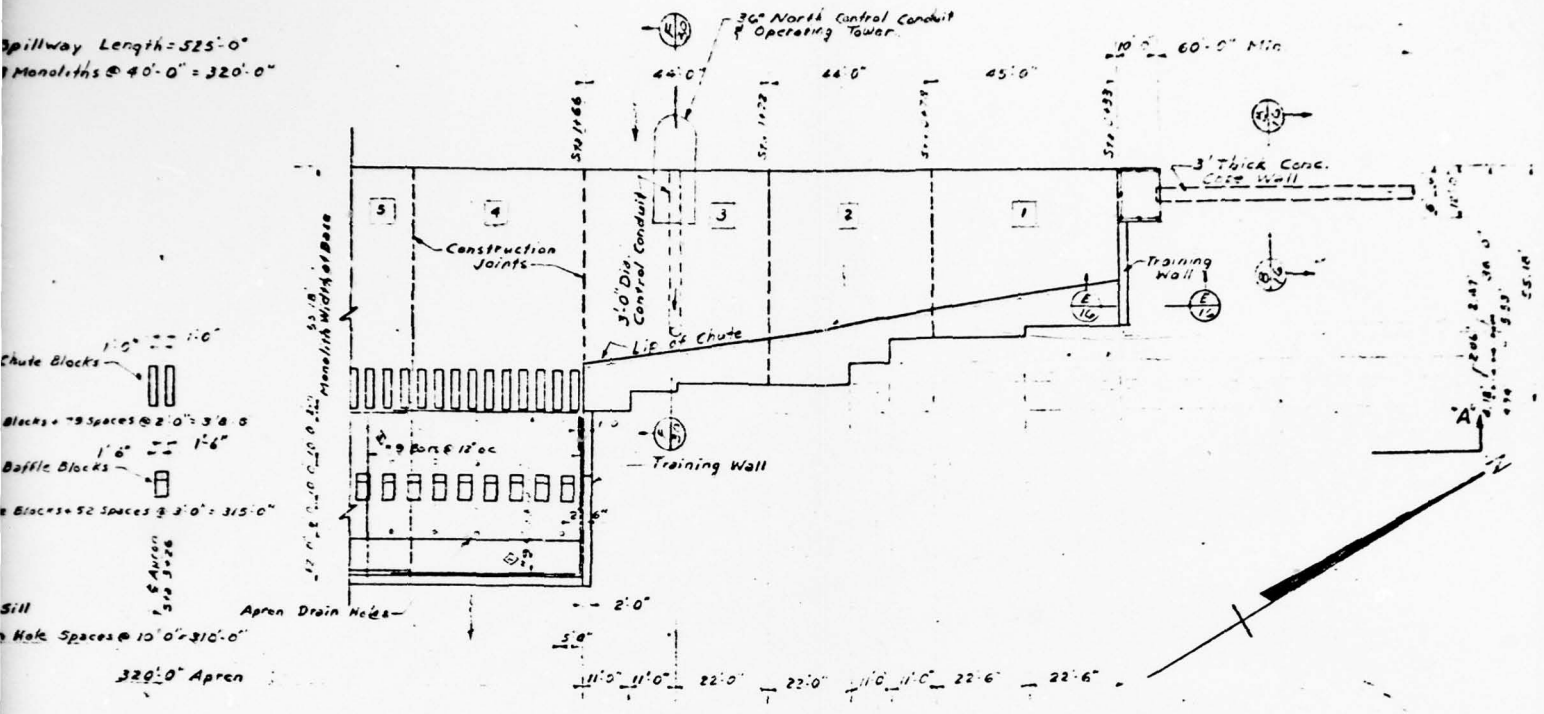


GENERAL PLAN OF DAM
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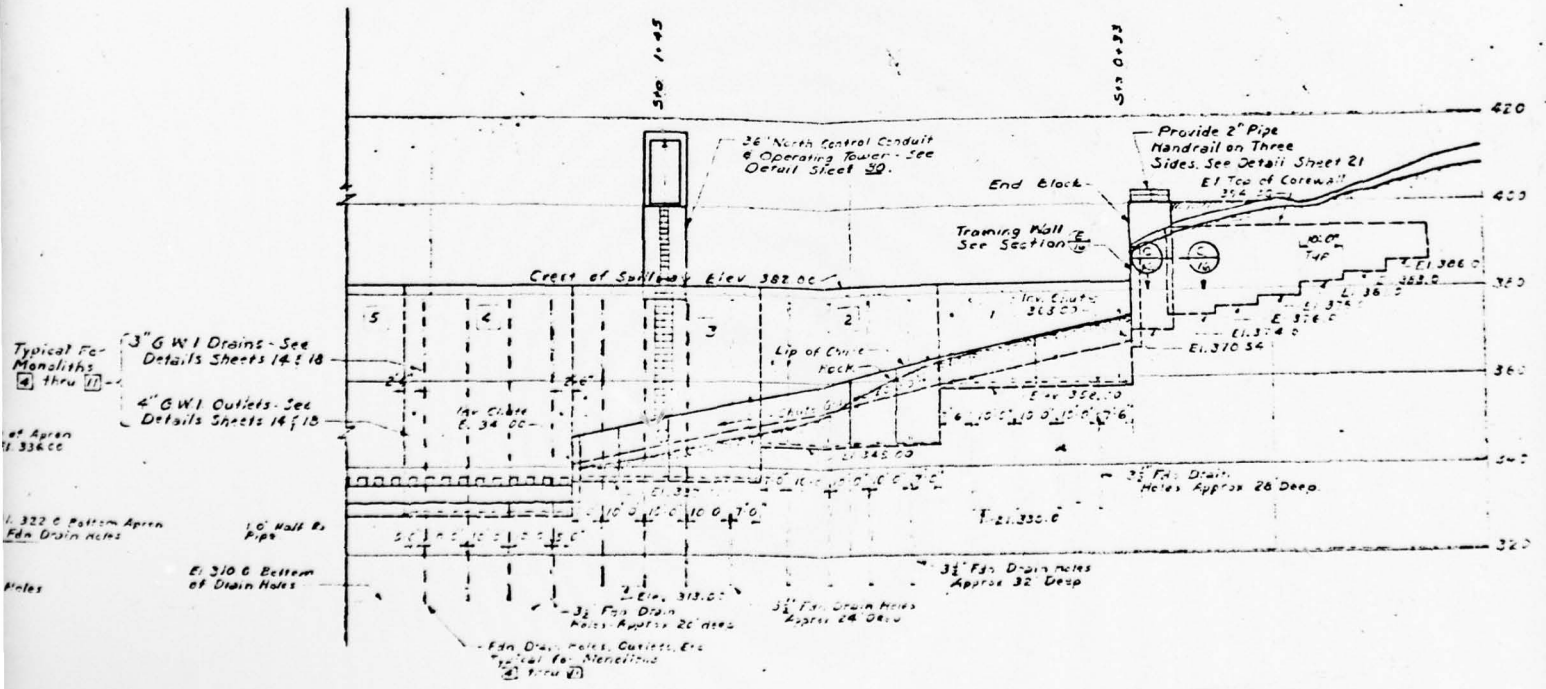


PLATE 2

SECTIONAL ELEVATION "A-A"
Scale: 1"=20'

CHARLOTTESVILLE, VIRGINIA
WATERWORKS IMPROVEMENTS
RIVANNA RIVER DAM & INTAKE
GENERAL PLAN AND SECTIONAL ELEVATIONS OF DAM

POLGLAZE & BASENBERG
ENGINEERS
BIRMINGHAM ALABAMA

Dwg. No. 417-D

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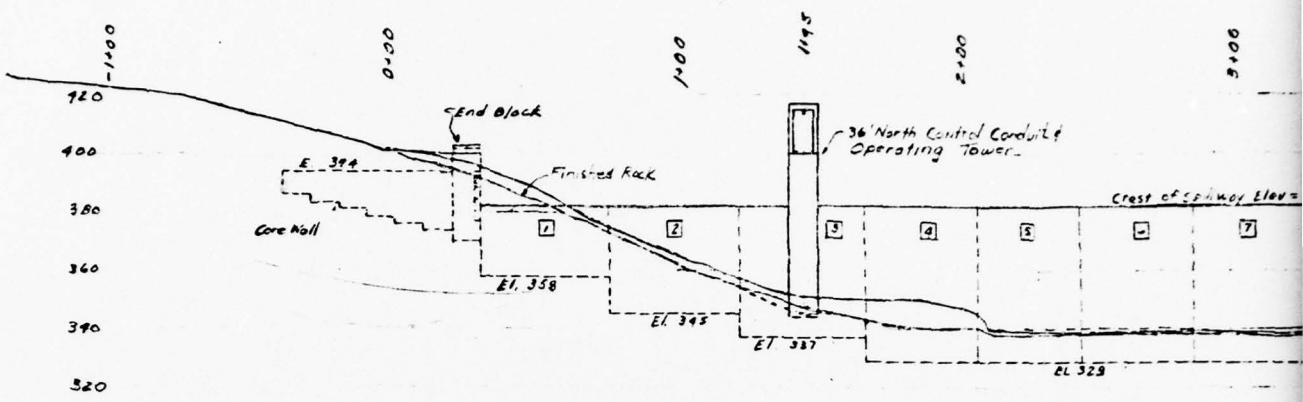
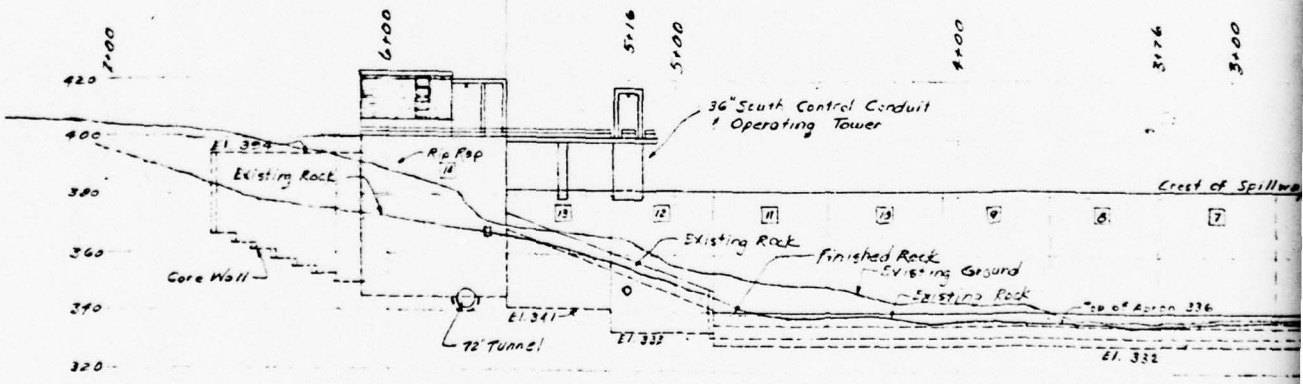
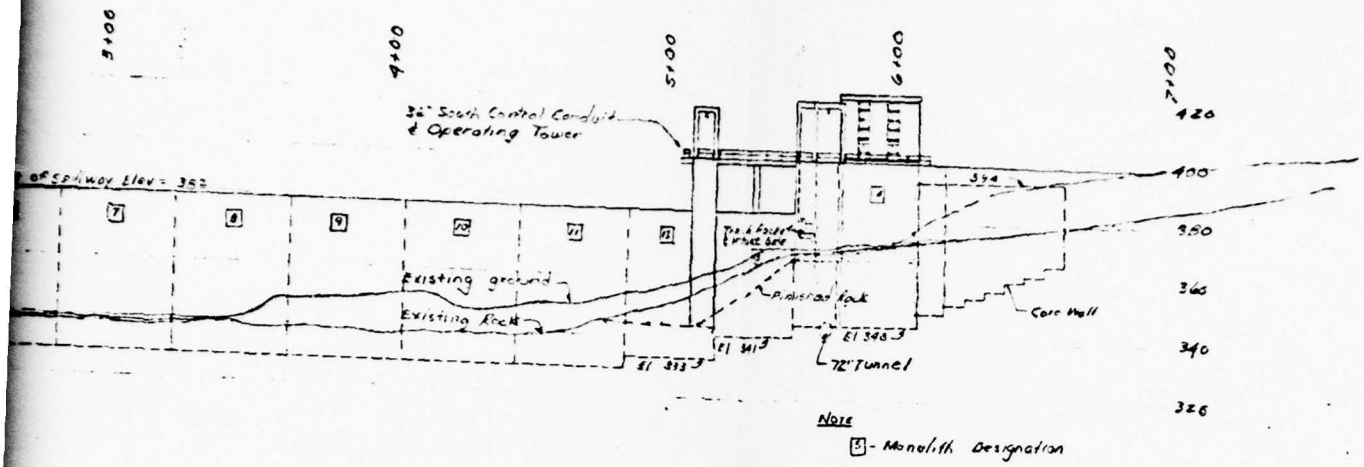



UPSTREAM ELE
Scale: 1"=30

Spillway Length = 5




DOWNSTREAM ELE
Scale: 1"=3

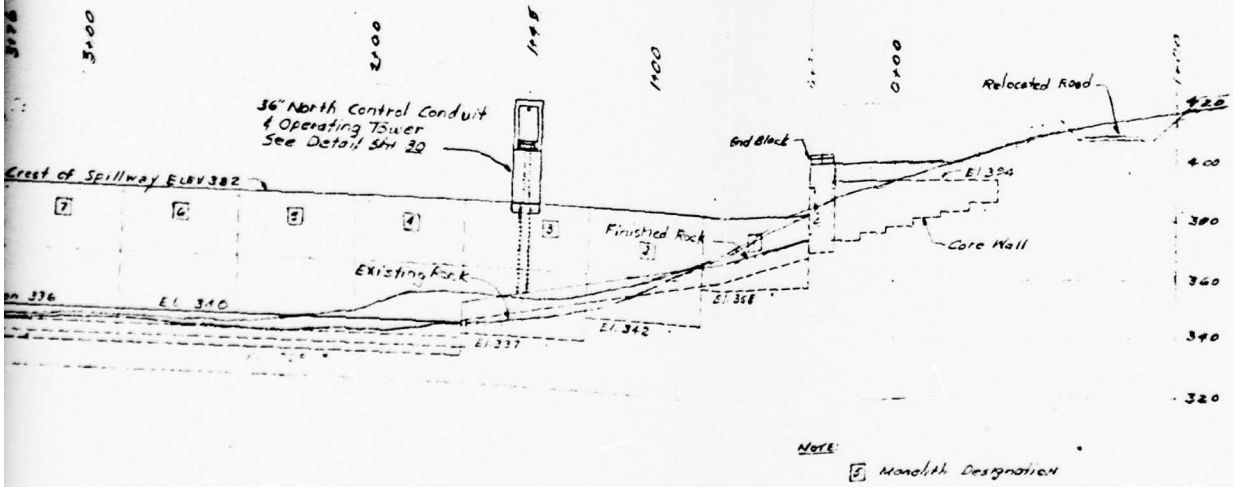



Note

[5] - Monolith Designation

REAM ELEVATION
Scale: 1"=30'

Length = 525'




Note

[5] Monolith Designation

EAM ELEVATION
Scale: 1"=30'



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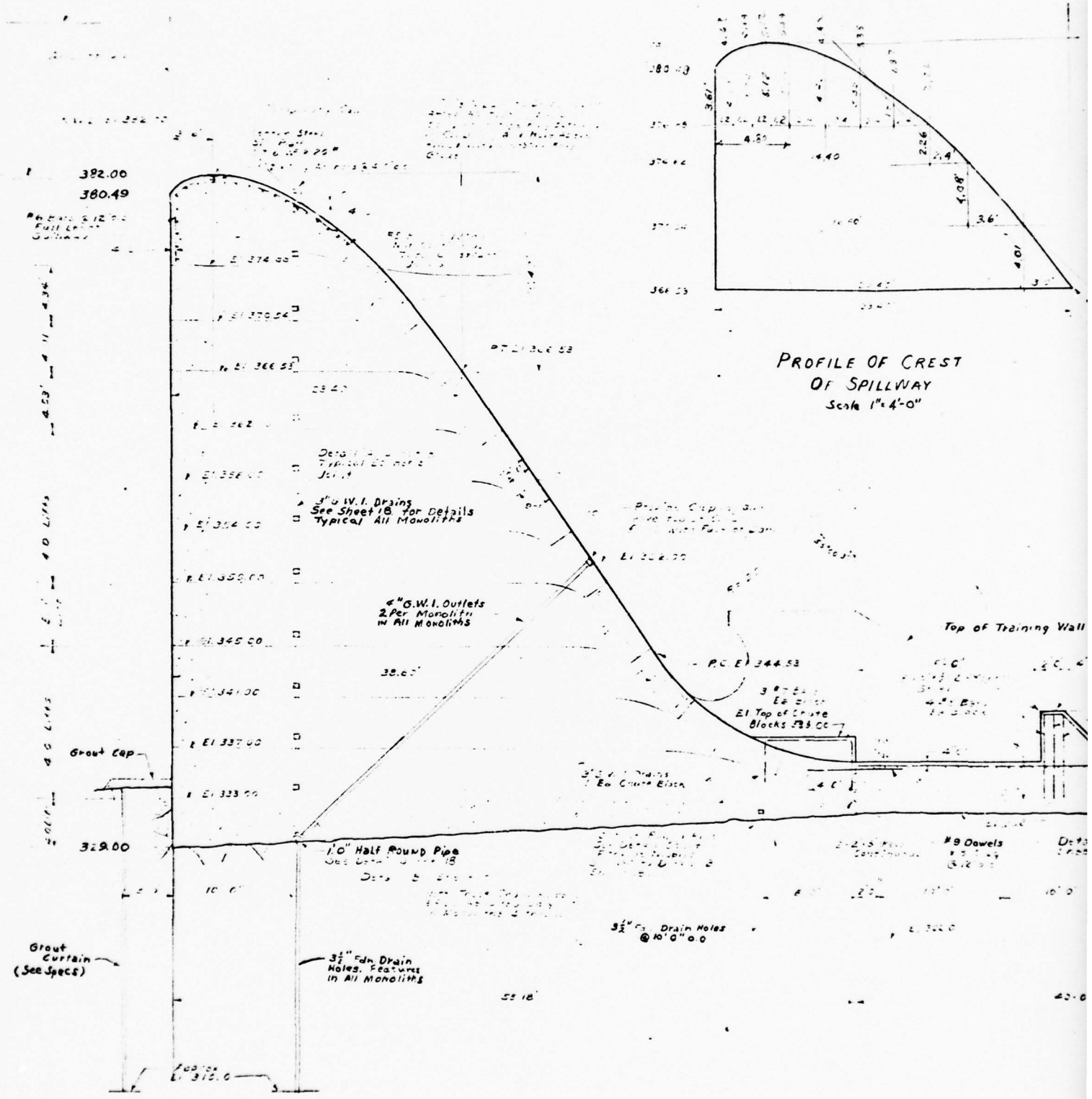
**PLATE 3**

2.

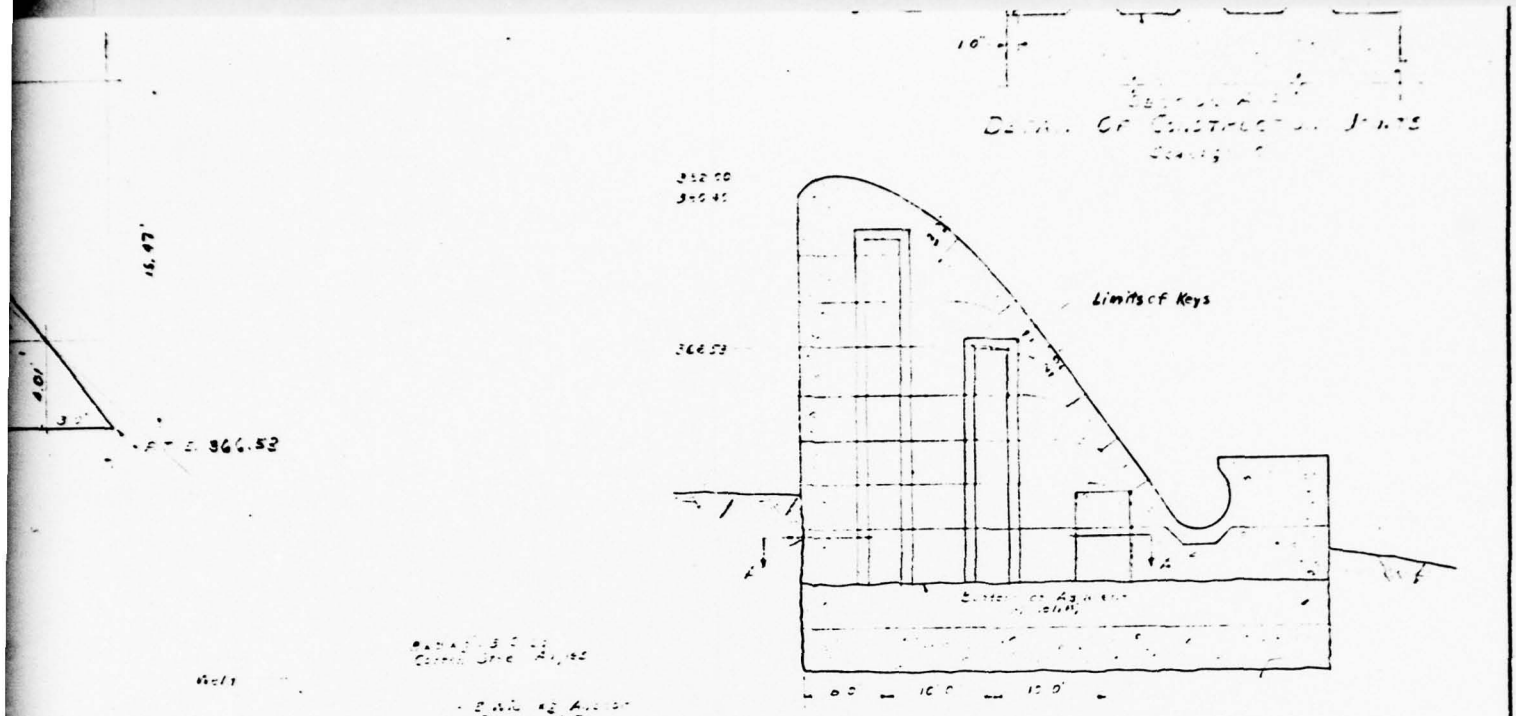
| | |
|---|---|
| DRAWN / TRACED | CHARLOTTESVILLE, VIRGINIA |
| CHECKED | WATERWORKS IMPROVEMENTS |
| APPROVED | RIVANNA RIVER DAM & INTAKE |
| DATE 1"=30' | UPSTREAM AND DOWNSTREAM ELEVATIONS OF DAM |

POLGLAZE & BASENBERG
ENGINEERS
BIRMINGHAM ALABAMA

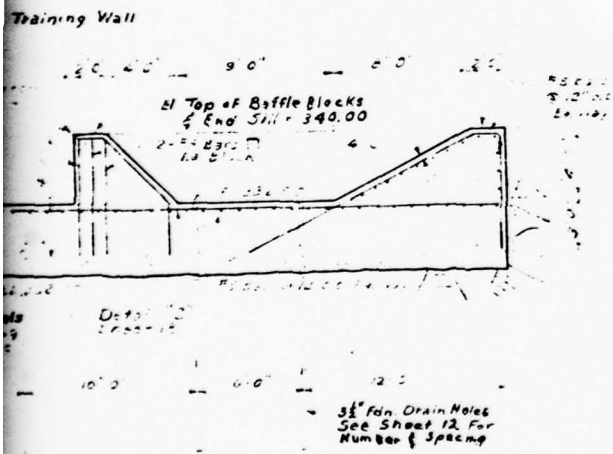


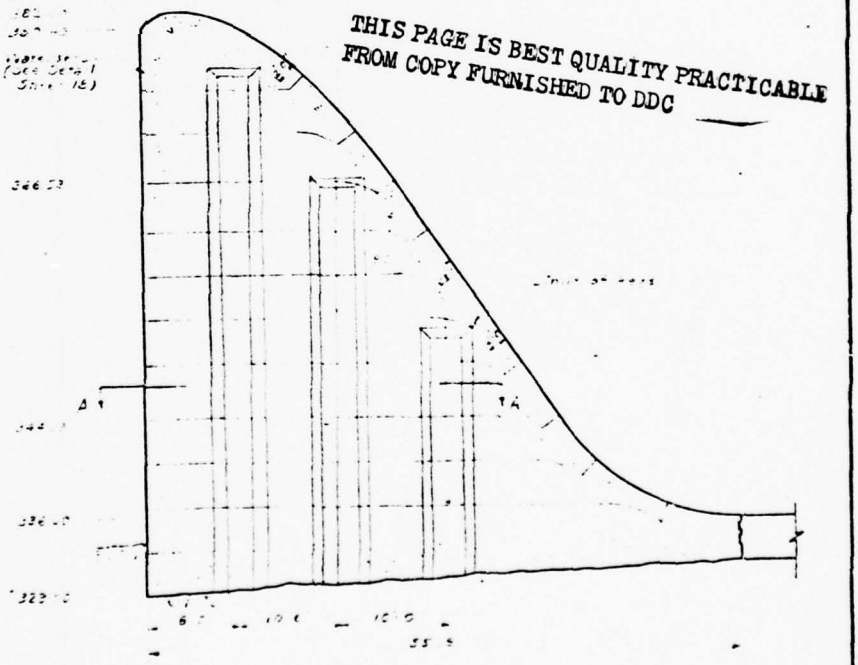

PROFILE OF CREST OF SPILLWAY
Scale 1"=4'-0"

TYPICAL SPILLWAY & APRON SECTION
STA. 1+66 TO STA. 4+86
Scale: 1"=5'-0"




TYPICAL DETAIL OF CONSTRUCTION JOINTS
MONOLITHS 1 2 3 12 13 & 14
Scale: 1/8" = 1'0"



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TYPICAL DETAIL OF CONSTRUCTION JOINTS
SPILLWAY SECTION
Scale: 1/8" = 1'0"

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PLATE 4

CHARLOTTESVILLE VIRGINIA
WATERWORKS IMPROVEMENTS
RIVANNA RIVER DAM & INTAKE
TYPICAL SPILLWAY AND APRON SECTION

POLGLAZE & BASENBERG
ENGINEERS
BIRMINGHAM ALABAMA

2.

POLGLAZE & BASENBERG
ENGINEERS
BIRMINGHAM ALABAMA

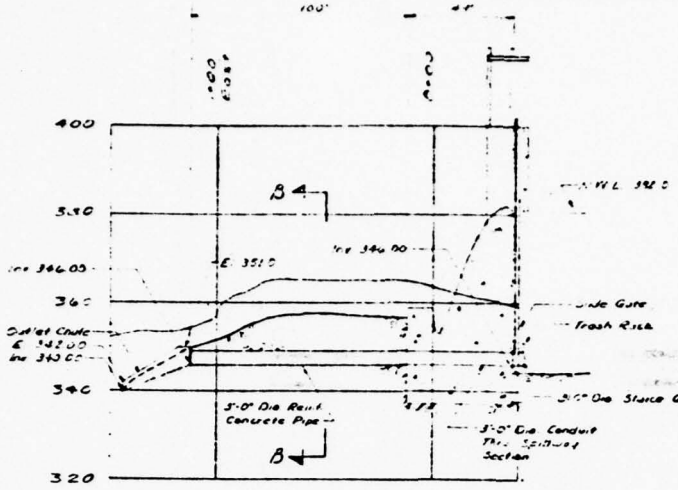
Job No. 417-D

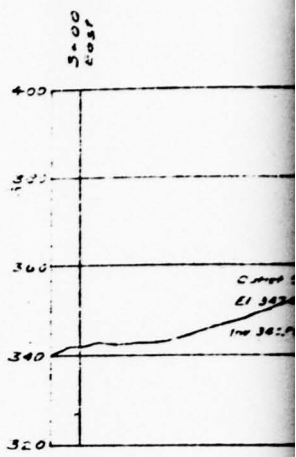
Sheet 19 of 33

CHARLOTTESVILLE, VIRGINIA
WATERWORKS IMPROVEMENTS
RIVANNA RIVER DAM & INTAKE

DRAIN TUNNELS AND
OUTLET STRUCTURES

| DRAWN | TRACED |
|---|---|
| CHECKED | |
| APPROVED | |
| SCALE AS NOTED | |
| DATE MAY 1964 | |

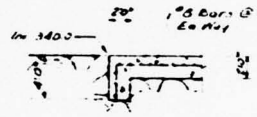



PROFILE
36" SOUTH CONTROL CONDUIT
Scales: Horiz. 1" = 40'
Vert. 1" = 20'



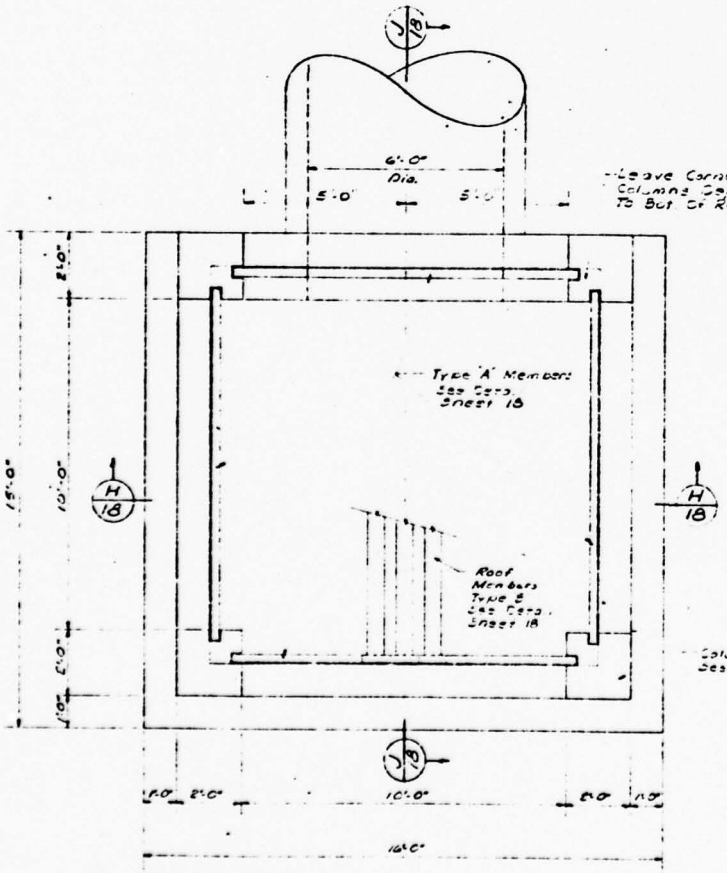





SECTION G-G
Scale 1/2" = 1'-0"

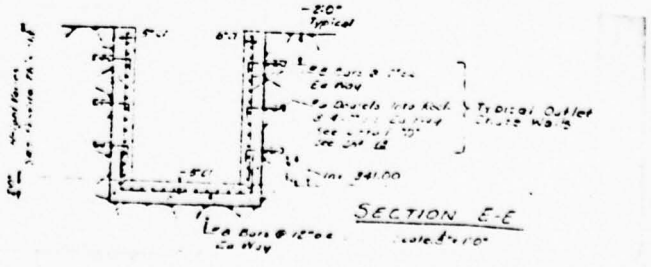



PLAN - OUTLET CHUTE
6'-0" DRAIN TUNNEL
Scale 1/8" = 1'-0"

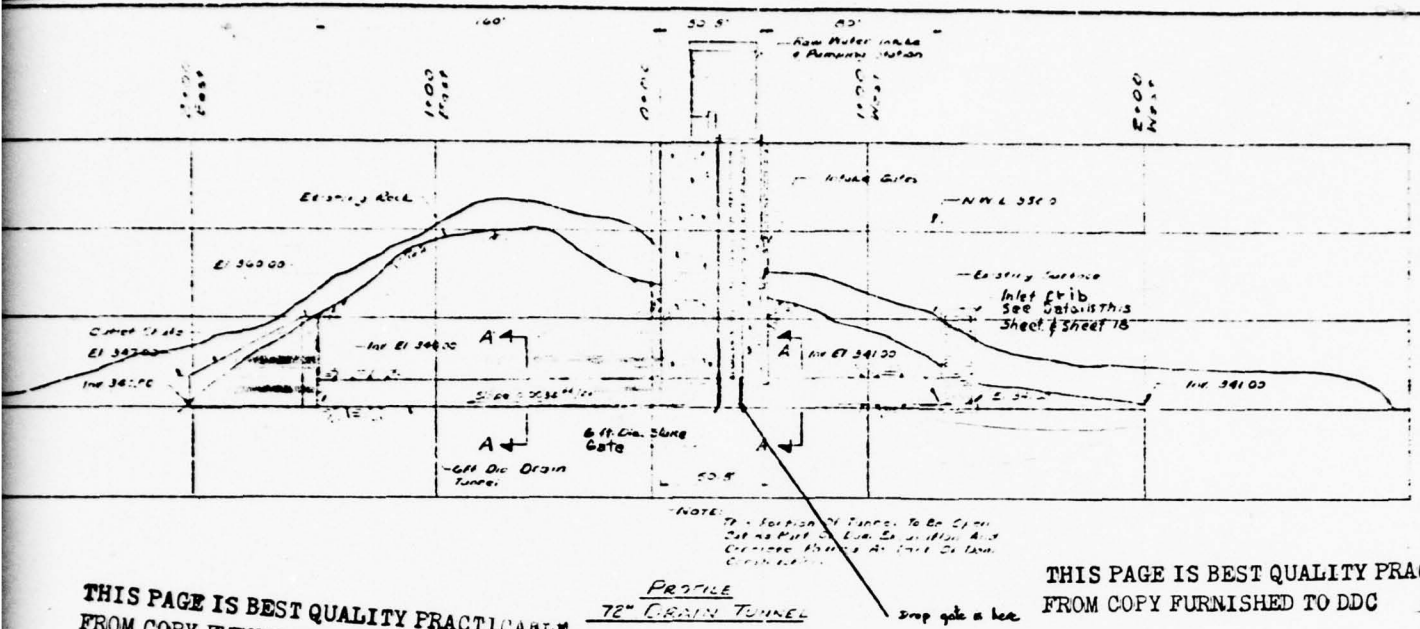



PLAN
INLET CRIB - 72" DRAIN TUNNEL
Scale 1/8" = 1'-0"

Columns See Detail Sheet 18




SECTION E-E
Scale 1/2" = 1'-0"




PROFILE
72" DRAIN TUNNEL



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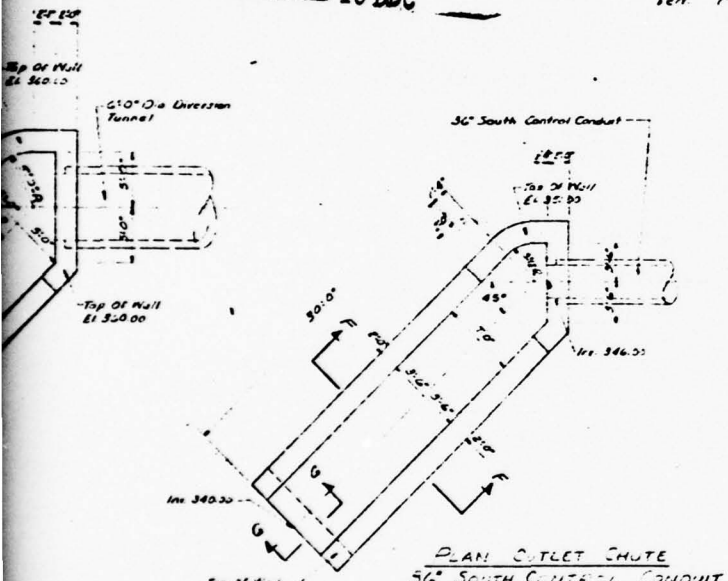
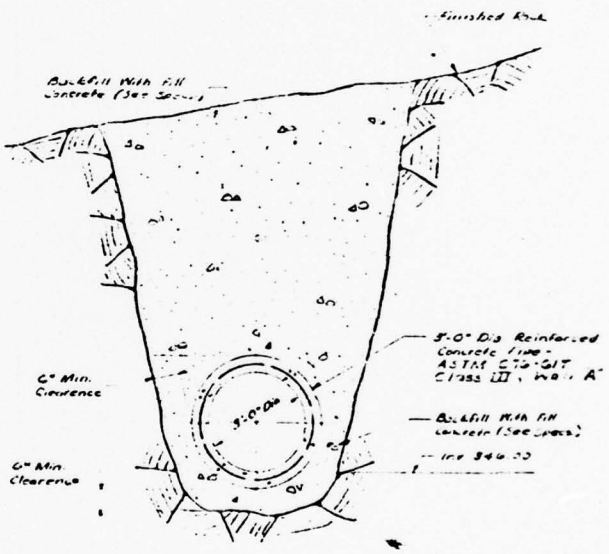
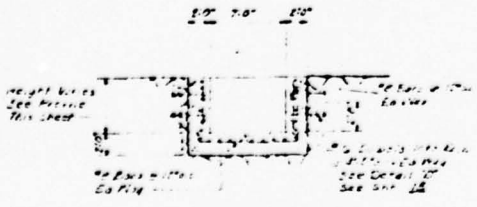



PLAN OUTLET CHUTE
36" SOUTH CONTROL CONDUIT

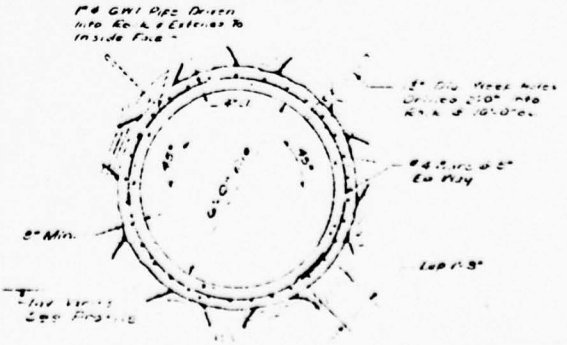



SECTION B-B

OUTLET CHUTE
TUNNEL



SECTION E-E




SECTION A-A

PLATE 5

2.

# APPENDIX II

# PHOTOGRAPHS

CONTENTS



Note: Photographs were taken 26 July 1978.

## SOUTH RIVANNA DAM

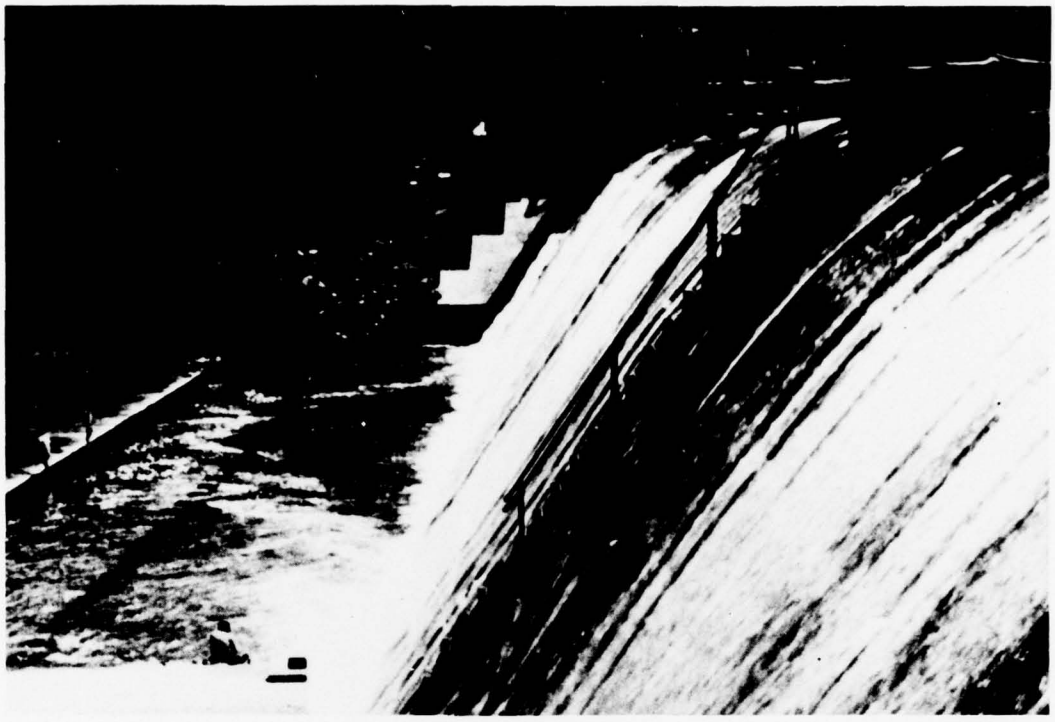


PHOTO 1. View of Dam, Left Chute and Stilling Pond From Abutment Area

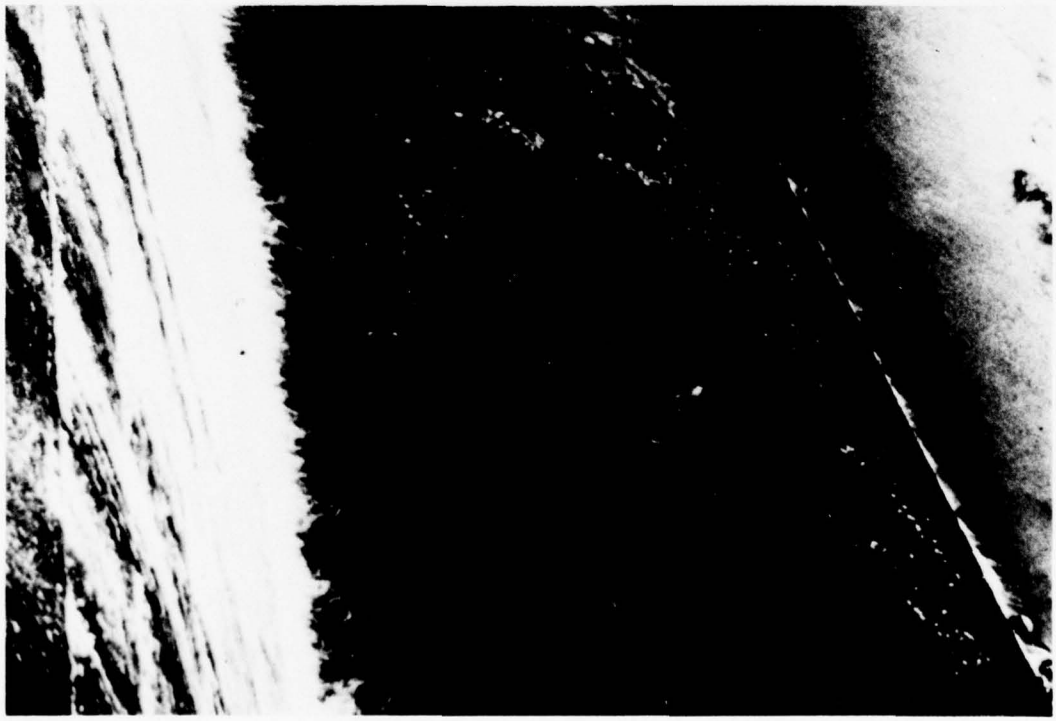


PHOTO 2. View of Baffle Blocks and End Sill of Stilling Pool

PHOTO 3. View of Upstream Face of Right Non-Overflow Section Directly Above Sluice Gates

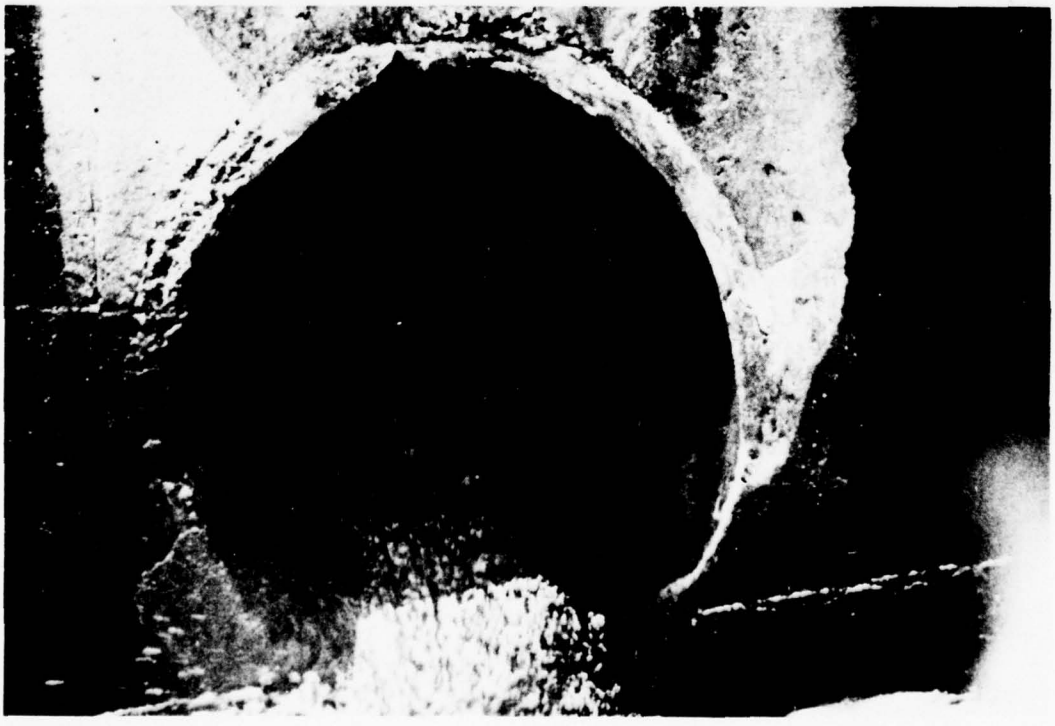


PHOTO 4. View of Outlet of 36 Inch Diameter North Control Conduit

PHOTO 5. View of Reservoir Showing Aeration Bubbles and Aquatic Vegetation on Far Bank

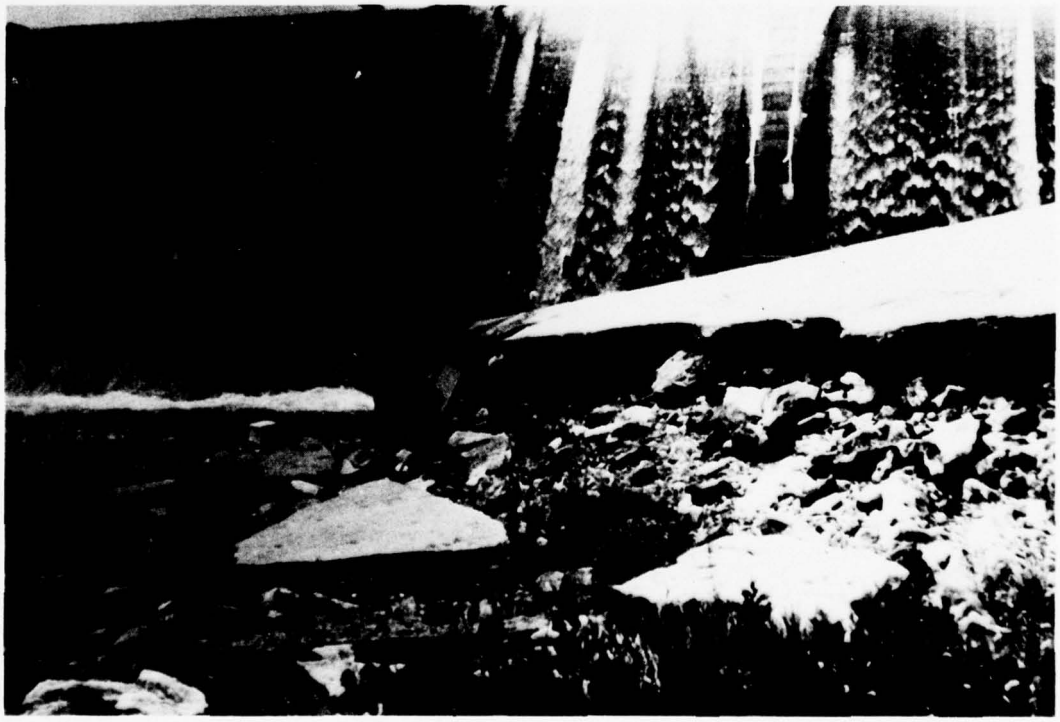


PHOTO 6. View of Deteriorated Concrete Apron Downstream of Left Abutment Area

# APPENDIX III

## CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase 1

Name Dam South Rivanna County Albemarle State Virginia Coordinates Lat. 3806.0 Long. 7828.0

Date Inspection 26 July 1978 Weather Cloudy, Rain Temperature 75°F.

Pool Elevation at Time of Inspection 382.0 M.S.L. Tailwater at Time of Inspection 336.0 M.S.L.



Inspection Personnel:

VIRGINIA WATER CONTROL BOARD:

Bill Lorenz

MICHAEL BAKER, JR., INC.:

M. H. Moore
T. J. Dougan
W. L. Sheafer

M. H. Moore Recorder

# CONCRETE/MASONRY DAMS

SOUTH RIVANNA

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SEEPAGE | None was observed in the abutment areas on both sides. | |
| STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS | The boring logs indicate that the left abutment of the structure is founded on light gray and brown coarse-grained quartz monzonite with a massive structure and some jointing. The right abutment is on hard quartz monzonite and green seamy hornblonde gabbro. There are traces of chlorite schist as indicated in the boring logs on the right side. The bedrock exposure downstream on the right side is blocky and highly jointed (vertical). There are clay and soft fractured seams with some talus. | |
| DRAINS | According to the plans, 3.5 inch diameter apron foundation drains are present in the concrete apron downstream of the main spillway and in the foundation area. They were not visible for inspection. | |
| WATER PASSAGES | A six feet diameter drain tunnel located under the intake structure in the right abutment area was not accessible for inspection. Chutes located in the left and right abutment areas were passing overflow at time of inspection. No signs of deterioration or obstructions. | |
| FOUNDATION | The foundation of the dam is on light gray quartz monzonite based on the geologic cross sections. Rock exposures in the vicinity are massive with some joints. The bedrock is in the Pre-Cambrian Lovinston Formation. | |

HHH-2

## CONCRETE/MASONRY DAMS

SOUTH RIVANNA

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SURFACE CRACKS CONCRETE SURFACES | A small number of hairline surface cracks were present in the dam and its appurtenances. The concrete apron downstream from the chute in the left abutment area has been undermined and is in poor condition. | The concrete apron should be repaired to prevent erosion during periods of high flows. |
| STRUCTURAL CRACKING | No structural cracking was observed and all concrete appeared to be in good condition. | |
| VERTICAL AND HORIZONTAL ALIGNMENT | No horizontal or vertical misalignment was observed at the time of inspection. | |
| MONOLITH JOINTS | All monolith joints were in good condition. | |
| CONSTRUCTION JOINTS | All construction joints were in good condition. No spalling or calcite stains were present in these areas. | |
| ROCKFILL | Large blocks of very hard rock of various types were placed on the downstream slopes on both sides adjacent to the concrete to act as backfill and riprap for the stilling basin. The surface was covered with approximately five inches of concrete. | |

## OUTLET WORKS

SOUTH RIVANNA

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT | Two 36 inch diameter control conduits and one six feet diameter drain tunnel extend through the dam. There was no evidence of cracking or spalling at the outlets. The entire length of the tunnel could not be inspected because flow was present at the time of inspection. | |
| INTAKE STRUCTURE | The intake structure and its appurtenances above water level were in good condition. The actual intake through the sluice gates could not be seen. It was well below water level. | |
| OUTLET STRUCTURE | No outlet structure was present at the dam other than a paved section from the six feet drain tunnel. No inadequacies were observed. | |
| OUTLET CHANNEL | The outlet channel for the six feet drain tunnel is in good condition. No inadequacies were noted. | |
| EMERGENCY GATE | The design drawings indicate a 72 inch circular sluice gate and two 36 inch circular sluice gates on the outlet pipes. | |

## UNGATED SPILLWAY

SOUTH RIVANNA

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONCRETE WEIR | See comments on CONCRETE/MASONRY DAMS. | |
| APPROACH CHANNEL | Not Applicable | |
| DISCHARGE CHANNEL | The baffle blocks and end sill in the stilling basin downstream of the ogee spillway are in good condition with no inadequacies observed. | |
| BRIDGE AND PIERS | A small number of hairline cracks were observed in the pier of the north and the south control conduit towers. | |

## INSTRUMENTATION

SOUTH RIVANNA

| VISUAL EXAMINATION | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| MONUMENTATION/SURVEYS | There are none. | |
| OBSERVATION WELLS | There are none. | |
| WEIRS | There are none. | |
| PIEZOMETERS | There are none. | |
| OTHER | | |

## RESERVOIR

SOUTH RIVANNA

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SLOPES | The slopes on the right side are generally steep at the shoreline which consists of silt, sand and rock fragments with some hard quartz monzonite exposures. The slopes above the shoreline are moderate. There is stone riprap between the dam and a boat ramp. The slopes on the left side are steeper than the right side and densely wooded with more exposures of massive quartz monzonite. | |
| SEDIMENTATION | A small amount of sedimentation along the left bank for approximately 300 feet upstream of the spillway was indicated by shoreline vegetation. | |

## DOWNSTREAM CHANNEL

SOUTH RIVANNA

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) | The channel is in sand, gravel, cobbles and boulders with some bedrock exposed. A "geologic dike" is shown on the plans. There are some low islands which are covered with vegetation and minor debris. | The channel is clear of obstructions. |
| SLOPES | The banks are low on the left side in silt, sand and gravel with cobbles. The valley walls on both sides are steep with exposures of hard quartz monzonite with some jointed gabbro on the right side. | |
| APPROXIMATE NO. OF HOMES AND POPULATION | Approximately 200 homes and 800 people are located on the right bank downstream from the dam in the Towns of Carrsbrook and Westmoreland. Based on U.S.G.S. topographic maps, the majority of the homes are 20 feet above the crest of the dam. | |

# APPENDIX IV

## CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

SOUTH RIVANNA

| ITEM | REMARKS |
|---|---|
| PLAN OF DAM | A plan is enclosed (see Plate 1) |
| REGIONAL VICINITY MAP | A vicinity map is enclosed as the Location Plan. |
| CONSTRUCTION HISTORY | No construction records are available. |
| TYPICAL SECTIONS OF DAM | A dam section is shown in Plate 4. |
| HYDROLOGIC/HYDRAULIC DATA | Design storage curves and a Corps of Engineers Flood Plain Study were available. |
| OUTLETS - PLAN | Plan and details are shown on Plates 1 and 5. |
| - DETAILS | |
| - CONSTRAINTS | None were available. |
| - DISCHARGE RATINGS | None were available. |
| RAINFALL/RESERVOIR RECORDS | Flood discharge information is available for the Earlysville stream gauging station from 1951-1966. A flood plain study done in 1973 by the C.O.E. contains hydrological records. |

SOUTH RIVANNA

| ITEM | REMARKS |
|---|---|
| DESIGN REPORTS | None are available. |
| GEOLOGY REPORTS | None are available. |
| DESIGN COMPUTATIONS | None are available. |
| HYDROLOGY & HYDRAULICS | |
| DAM STABILITY | |
| SEEPAGE STUDIES | |
| MATERIALS INVESTIGATIONS | Boring records are shown in cross sections with the geologic cross sections. |
| BORING RECORDS | |
| LABORATORY | |
| FIELD | |
| POST-CONSTRUCTION SURVEYS OF DAM | None are available. |
| BORROW SOURCES | Borrow areas were not indicated on the plans. |

SOUTH RIVANNA

| ITEM | REMARKS |
|---|---|
| MONITORING SYSTEMS | There are none. |
| MODIFICATIONS | There are none. |
| HIGH POOL RECORDS | None were available. |
| *POST-CONSTRUCTION ENGINEERING* STUDIES AND REPORTS | None were available. |
| PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS | None were available. |
| MAINTENANCE OPERATION RECORDS | Maintenance records are available at the treatment plant approximately one-half mile south of the dam. |

SOUTH RIVANNA

| ITEM | REMARKS |
|---|---|
| SPILLWAY PLAN | |
| SECTIONS | A typical section is shown on Plate 4. |
| DETAILS | Spillway details are included in the design plans. |
| OPERATING EQUIPMENT PLANS & DETAILS | Intake structure and operating tower details are included in the design plans. |

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 259 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 382.0 (6400 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 400.0 (17,800 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 400.0

ELEVATION TOP DAM: 400.0

CREST: Ungated Spillway

a. Elevation 382.0
b. Type Ogee spillway
c. Width Approximately 3.5 feet wide at crest
d. Length 525 feet
e. Location Spillover Entire length of ogee spillway
f. Number and Type of Gates Three 2'-6" square sluice gates for intake of raw water that is pumped to the treatment plant one-half mile south of dam

OUTLET WORKS:

a. Type Two 36 inch diameter control conduits
b. Location North and south control towers adjacent to left and right abutments
c. Entrance inverts 346.0 south control conduit
d. Exit inverts 346.0 south control conduit
e. Emergency draindown facilities 6'-0" diameter drain tunnel

HYDROMETEOROLOGICAL GAGES:

a. Type Streamflow gage
b. Location 5.6 miles upstream of dam at Hydraulic, Virginia
c. Records 1951 thru 1966

MAXIMUM NON-DAMAGING DISCHARGE Not known

# APPENDIX V

# DESIGN REPORT - HYDROLOGY SECTION

5. Reservoirs

We conclude from the above that the South Fork of the Rivanna River will provide a dependable source of supply to the City of Charlottesville to approximately the year 1990 if a dam with crest of spillway at Elevation 382 is constructed approximately 1/2 mile upstream from Highway 29.

A flood on the South Fork with a Meyer Rating of 4,000 would have a maximum discharge of approximately 64,000 c.f.s. at the site of the proposed dam, and the runoff would be approximately 249 c.f.s. per square mile. A flood on the South Fork with a Meyer Rating of 5,000 would have a discharge of approximately 80,400 c.f.s. at the site of the proposed dam, and the runoff would be approximately 311 c.f.s. per square mile. A dam with a spillway length of approximately 600 feet can be constructed at the proposed site, and with a flood discharge of 80,400 c.f.s., the discharge per lineal foot of spillway would be approximately 134 c.f.s., and the head over the spillway would be approximately 11.74 feet. The head over the spillway with a flood discharge of 64,000 c.f.s. and spillway length of 600 feet would be approximately 10.1 feet, or the water level at the spillway would be at approximately Elevation 392 with the spillway crest at Elevation 382.

The greatest flood of record on the South Fork had a discharge of 30,200 c.f.s. at the Earlysville gauging station, and this flood occurred on August 18, 1955. The estimated discharge at the site of the proposed dam during this flood was 36,190 c.f.s. based on additional drainage area between the Earlysville gauging station and the site of the proposed dam. The discharge per lineal foot of spillway would be approximately 60.3 c.f.s. (spillway length 600 feet), and the head over the spillway with this discharge would be approximately 7.0'.

A flood with a Meyer Rating of 4,000 or 5,000 would be considerably greater than any recorded for this water shed and similar water sheds in this area, and we believe that a spillway designed for a rate of discharge of approximately 80,000 c.f.s. would be adequate.

There is a bridge crossing the South Fork of the Rivanna River at Hydraulic, approximately 1.5 miles upstream from the site of the proposed dam. The deck of this bridge is at Elevation 381.49. There is also a bridge crossing Ivy Creek at Hydraulic, and the deck of this bridge is at Elevation 371. It would be necessary to replace both of these bridges with new bridges at higher elevation if a dam were constructed on the South Fork at the proposed site with the spillway crest at Elevation 382. In addition, there are several buildings and houses that would be flooded if a reservoir were created with normal water level at Elevation 382.

We have, in cooperation with the City Engineer, made preliminary surveys of the roads and bridges crossing the South Fork of the Rivanna River and Ivy Creek at Hydraulic, and from these surveys estimate that new roads and bridges with bridge deck at Elevation 400 could be constructed for a cost of approximately $352,300, and this cost must be taken into consideration when evaluating the feasibility of constructing a dam and reservoir on the South Fork of the Rivanna River.

Our calculations indicate that with spillway crest at Elevation 382 the water level under the bridges at Hydraulic with various flood conditions would be as follows:

| Flood Discharge at Dam | Water Level at Dam | Water Level at Hydraulic |
|---|---|---|
| 36,200 c.f.s. | Elevation 389 | Elevation 391-392 |
| 64,000 c.f.s. | Elevation 392 | Elevation 395-396 |
| 80,000 c.f.s. | Elevation 394 | Elevation 398-399 |

This dam would not be equipped with crest gates, and thus all expense of structural steel supports, steel gates and gate hoisting equipment would be avoided. In addition to avoiding the initial expense of installing crest gates, the cost of maintaining and operating gates, as well as the risk of malfunctioning of gate equipment, would be completely eliminated.

In the event it were found desirable to increase the storage capacity of the reservoir in the future, flash boards could be installed on the crest of the spillway to raise the water level to Elevation 385 or 386, which would result in an increase of gross storage capacity of approximately 25% - 35% depending upon the height of the flash boards. The flash boards would be of the collapsible type and, therefore, it would not be necessary to have gate lifting equipment and at the same time malfunctioning of gate lifting equipment would still be eliminated. This feature of a dam on the South Fork (elimination of crest gates) makes the South Fork Reservoir very attractive as a source of supply for the City of Charlottesville.

The normal water level at the dam with spillway crest at Elevation 382 would vary from Elevation 382 to Elevation 385 depending upon the discharge of the river. The normal water level at Hydraulic would vary from approximately El. 382 to El. 387. The water level at Hydraulic would be at approximately Elevation 392 with a discharge over the spillway of approximately 36,200 c.f.s., and we believe it would be desirable to purchase all property within the re-

# APPENDIX VI

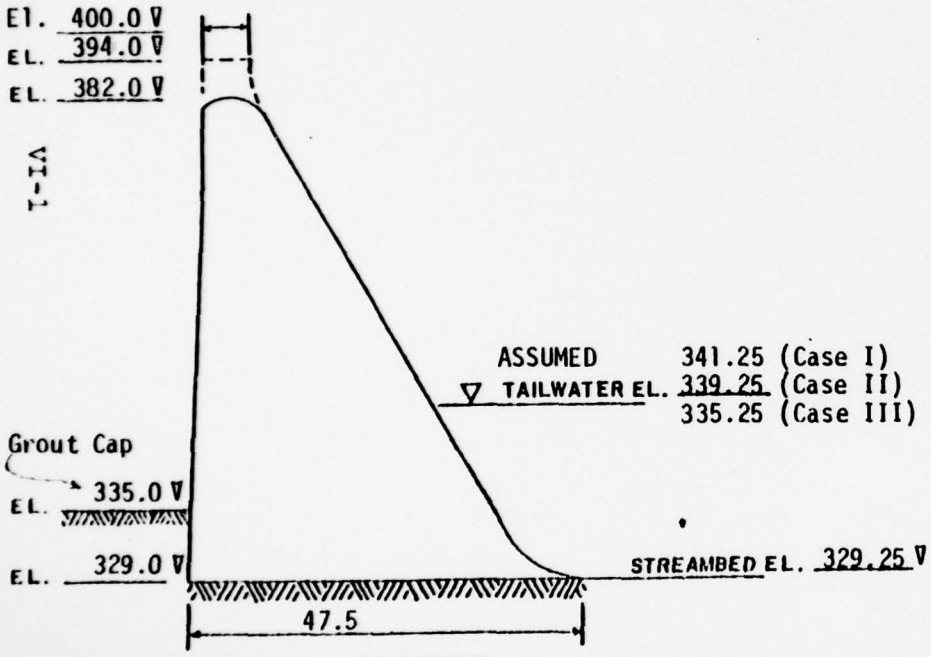
# STABILITY ANALYSES

# GRAVITY DAM DESIGN
## STABILITY ANALYSIS

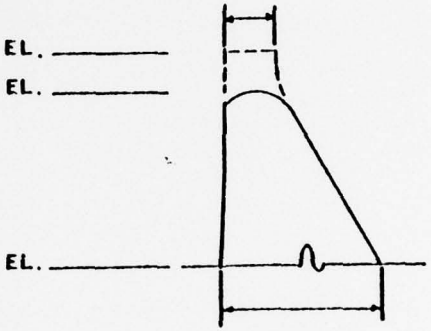
SOUTH RIVANNA

ANALYSIS DONE ON X FULL SECTION ___ PARTIAL SECTION
LOCATION OF SECTION At midpoint of dam
ANALYSIS PREPARED BY T. J. Dougan, Michael Baker, Jr., Inc.

| LOADING CASE | ELEV. HEAD WATER | ELEV. TAIL WATER | ΣV | ΣH | ΣH/ΣV | LOCATION RESULTANT FROM TOE | % BASE IN COMPRESSION | FACTOR SAFETY SLIDING | FOUNDATION PRESSURE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | TOE | HEEL |
| Case I P.M.F. | 400.0 | 341.25 | 145,653# | 117,395# | .81 | 16.4' | 100 | 107 (1) | 5913 psi | 219 psi |
| Case II 1/2 P.M.F. | 394.0 | 339.25 | 155,569# | 101,156# | .65 | 18.00' | 100 | 124 (1) | 5654 psi | 896 psi |
| Case III Normal Pool Ice Load | 382.0 | 335.25 | 174,903# | 78,647# | .45 | 21.4' | 100 | 160 (1) | 4775 psi | 2589 psi |




FULL SECTION




PARTIAL SECTION (NA)

(1) Quartz Monzonite
Ø = 31°
So = 1825 psi
From ETL 1110-2-184